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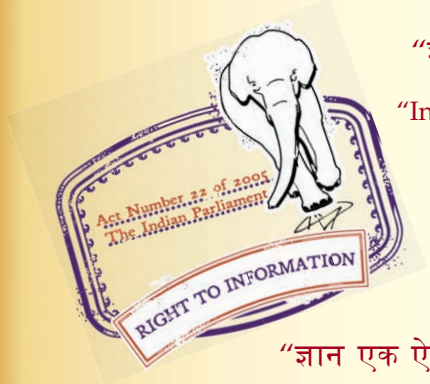

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IS : 8686 - 1977
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SPECIFICATION FOR STATIC PROTECTIVE RELAYS

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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SPECIFICATION FOR STATIC PROTECTIVE RELAYS

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SPECIFICATION FOR STATIC PROTECTIVE RELAYS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 28 October 1977, after the draft finalized by the Relays Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The requirements for the electrical relays used for power system protection are covered in IS : 3231-1965*. This standard has been prepared with a view to cover the additional requirements for static relays than those covered in IS : 3231-1965*.

0.3 In the preparation of this standard, assistance has been derived from IEC Pub 255-4 Single input energizing quantity measuring relays with dependent specified time, issued by the International Electrotechnical Commission.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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1. SCOPE

1.1 This standard covers static relays used for the protection of electrical equipment.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions in addition to those given in IS : 1885 (Part IX)-1966‡ and IS : 1885 (Part X)-1968§ shall apply.

2.1 Static Protective Relay — A protective relay in which the designed response is developed by electronic, magnetic or other components without mechanical motion.

*Specification for electrical relays for power system protection.
†Rules for rounding off numerical values (*revised*).
‡Electrotechnical vocabulary: Part IX Electrical relays.
§Electrotechnical vocabulary: Part X Electrical power system protection.

2.2 Static Relay with Output Contacts — A static relay having a contact in one or more of its output circuits.

2.3 Static Relay Without Output Contacts — A static relay having no contacts in its output circuit(s).

3. REQUIREMENTS

3.0 General — Transient voltages of short duration but of relatively high peak values may influence the relay circuit(s). These transient voltages can be generated by any sudden change of circuit condition, such as closing a switch in the auxiliary circuit or operating a line circuit breaker or isolator and can also be generated by switching within the relay itself. They can be transmitted to the relay through conductors; capacitive, inductive or magnetic coupling; or through earth paths. The transient voltage may appear across the relay circuit terminals, between circuits and earth, or between normally isolated circuits. To cover different field conditions, three levels of test voltage, namely, Class I, Class II and Class III have been specified. There may be sources of generation that will produce voltages higher than 5 kV at the relay. These should be reduced at the source of generation to the level of voltage appropriate to the class declared by the manufacturer of the relay.

3.1 The static relays shall conform to IS : 3231-1965* in addition to the requirements laid down in this standard.

3.2 Test Voltage Classes

Class	*Impulse Voltage Withstand Test*	*High Frequency Disturbance Test*
I	Zero	Zero
II	1 kV peak	a) *Longitudinal mode*—1 kV peak value of first half cycle b) *Transverse mode*—0·5 kV peak value of first half cycle.
III	5 kV peak	a) *Longitudinal mode*—2·5 kV peak value of first half cycle b) *Transverse mode*—1 kV peak value of first half cycle.

4. RECOMMENDED APPLICATION OF TEST VOLTAGE CLASSES

4.1 Class I (No Test: 0 kV) — Relays of this class are exempted from transient voltage test. Where a relay is used as part of a protective

*Specification for electrical relays for power system protection.

equipment it is not necessary to apply a withstand test voltage to the relay since the equipment will be tested in accordance with its own class.

4.2 Class II (Test with 1 kV) — Relays or relay circuits with a Class II test voltage level may be used where:

a) the auxiliary circuits (power supply circuits) of the relay are connected to a voltage supply used exclusively for the power supply of static relays. If the leads are short, and in the absence of switching on other circuits connected to the supply, the levels of transient voltage on the supply leads is low (below 1 kV);

b) the input energizing circuits of the relays are not connected directly to the current transformers and/or voltage transformers or where good screening and earthing is employed on the connecting leads;

c) the output circuits are connected to a load by short lead lengths; and

d) normally no voltage test is required but an extra high security is wanted.

4.3 Class III (Test with 5 kV) — Relays or relay circuits with a Class III test voltage level should be used where:

a) the auxiliary energizing circuits (power supply circuits) of the relay are connected to station batteries. Due to the long lead lengths longitudinal transient voltages of a relatively high value may appear on the supply leads and transverse voltages may arise from switching in other circuits connected to the same battery or supply source;

b) the input energizing circuits of the relay are connected to current transformers and/or voltage transformers and/or where long lead lengths are involved and no effective screening and earthing is employed;

c) the output circuits are connected to a load by long lead lengths with the result that longitudinal transient voltages of a relatively high value may appear at the output terminals; and

d) normally a lower test voltage in terms of **4.2**(a) and **4.2**(b) is sufficient but an extra high security is required.

NOTE — A relay may have different test voltage classes for its input energizing circuits, auxiliary energizing circuits and output circuits.

5. TESTS

5.1 Impulse Voltage Withstand Test — An impulse-voltage withstand test is performed to determine whether the relay and its individual components will withstand without damage high voltage surges of short duration.

For the withstand test the impulse voltage is an aperiodic transient voltage without appreciable oscillations.

5.1.1 *Test Circuit Conditions*

a) *Impulse waveform* — This shall be the standard 1·2/50 impulse as specified in IS : 2071 (Part II)-1974* and having the following tolerances:
Voltage rise time : ±30 percent,
Voltage fall time : ±20 percent.

b) *Source impedance* — 500 ohms with a tolerance of ±10 percent.

c) *Source energy* — 0·5 joule with a tolerance of ±10 percent.

d) *Standard value of test voltage* — As specified in **3.2** for the appropriate class. The test voltage levels are the voltages at the output of the test circuit before the relay is connected to the test circuit terminals.

e) *Test voltage tolerance* — $^{+0}_{-10}$ percent.

f) *Impulse generator circuit* — The recommended standard test circuit is shown in Fig. 1. The test leads shall not be longer than 2 m.

5.1.2 *Test Procedure*

5.1.2.1 Impulse test shall be regarded as type test only.

5.1.2.2 Three positive and three negative impulses shall be applied at intervals of not less than 5 seconds.

5.1.2.3 The impulse test shall be carried out as follows to the appropriate points of the circuit under test which are accessible from outside the case, the other circuits and the accessible metal parts of the relay intended to be earthed being connected together and to earth:

a) between all terminals connected together and earth,

b) between all independent circuits of the relay with the terminals of each Independent circuit connected together, and

c) between terminals of the same circuit except contact circuits (*see* Note 1).

NOTE 1 — It is not always necessary to carry out the impulse voltage withstand test between open metallic contacts. The requirement should be agreed between manufacturer and user, and the manufacturer should assign to the contact circuit a test voltage class.

NOTE 2 — Where energizing circuits (input and auxiliary) and output circuits of different test voltage classes are present on the same relay test as given in **5.1.2.3**(c) is carried out at the assigned class voltage of the circuit. All other tests are carried out at the highest class voltage assigned to any circuit within the relay.

*Method of high voltage testing: Part II Test procedures.

5.1.2.4 The test shall be carried out with all energizing and auxiliary energizing quantities disconnected from the relay.

5.1.3 *Criteria for Acceptance*

5.1.3.1 After the test the relay shall still comply with all relevant performance requirements specified in IS : 3231-1965*.

NOTE — A flashover (capacitance discharge) is not necessarily a criteria of failure as this may occur in a position that does no damage and the manufacturer shall decide whether or not to eliminate the cause provided other criteria of acceptance are met.

5.1.3.2 The impulse test is designed as a type test and should not normally be made on production relays. Since repeated stressing may reduce the performance and/or life, any impulse tests which are carried out after the relays leave the manufacturer's works should be limited to a maximum of 60 percent of the class voltage assigned by the manufacturer.

5.2 High Frequency Disturbance Test

5.2.1 High frequency disturbance test is recommended in order to determine whether a relay will operate in a faulty manner when specified high frequency transients which are representative of practical system conditions are applied to a fully energized relay.

NOTE — One frequency is considered to be justified as a test to be applied to all relays irrespective of design and gives a basic indication of the ability of the relay to withstand high frequency disturbances. Other test frequencies and other types of tests may be proved necessary in future and those will be added as experience develops.

5.2.2 *Test Circuit Conditions*

a) *Waveform* — A damped oscillatory wave with the envelope decaying to 50 percent of peak value at the end of 3 to 6 cycles.

b) *Frequency* — 1·0 MHz with a tolerance of ± 10 percent.

c) *Source impedance* — 200 ohms with a tolerance of ± 10 percent.

d) *Repetition rate* — The test wave is supplied to the relay under test at a repetitive rate of 400 per second.

e) *Duration of test* — 2 seconds with a tolerance of $^{+10}_{-0}$ percent.

(*see* Note under **5.2.3.7**)

f) *Standard value of test voltage* — As specified in **3.2** for the appropriate class. The test voltage levels are the voltages at the output of the test circuit before the relay to be tested is connected to the test circuit terminals.

*Specification for electrical relays for power system protection.

g) *Test voltage tolerance* — $^{+\ 0}_{-10}$ percent.

h) *Impulse generator circuit* — The recommended standard test circuits are shown in Fig. 2, 3 and 4. The test leads shall not be longer than 2 m.

5 2.3 *Test Procedure*

5.2.3.1 Disturbance test shall be regarded as Type test only.

5.2.3.2 The test shall be carried out with the relay under reference conditions.

5.2.3.3 The test shall be carried out with the following values of energizing quantities (auxiliary and input) applied to the appropriate circuits :

a) Auxiliary energizing quantity(ies) — Rated value(s).

b) Input energizing quantity(ies) — i) For all-or-nothing relays— zero and rated values.

ii) For measuring relay— rated value where appropriate (for example, frequency relays) or value(s) corresponding to setting value of the characteristic quantity as specified.

5.2.3.4 On measuring relays the test shall be carried out at both below and above the operating value of the characteristic quantity.

5.2.3.5 The test shall be carried out as follows at the appropriate points accessible from outside the relay case with the cover in position, with the accessible metal parts of the relay being earthed :

a) between each set of input or output terminals and earth (longitudinal,

b) between all independent circuits of the relay (longitudinal), and

c) between terminals of the same circuit where applicable (transverse).

NOTE 1 — Test as given in **5.2.3.5**(c) is not applicable to metallic contact circuits but should be applied to semiconductor output circuits.

NOTE 2 — Where energizing circuits (input and auxiliary) and output circuits of different test voltage classes are present on the same relay, test given in **5.2.3.5**(c) is carried out at the assigned class voltage of the circuit. All other tests are carried out at the highest class voltage assigned to any circuit within the relay.

5.2.3.6 The test shall be carried out and the effect checked, across one set of test points at the same time.

5.2.3.7 The test shall be carried out for a period of 2 seconds except for relays with an operating time greater than 2 seconds.

NOTE — It is recommended that the test be carried out with a time setting nearest to 2 seconds. Where the minimum time setting is greater than 2 seconds it may be convenient to extend the period of application of the disturbing signal to cover this minimum time.

5.2.3.8 The variation due to the effect of the disturbance test should be declared by the manufacturer.

5.2.4 *Criteria for Acceptance*

5.2.4.1 When the characteristic quantity is set at a value equal to the claimed variation below the operating value of the characteristic quantity the relay shall not operate during the disturbing period.

5.2.4.2 When the characteristic quantity is set at a value equal to the claimed variation above the operating value of the characteristic quantity the relay shall comply with the declared performance specification and shall not disengage during the disturbing period.

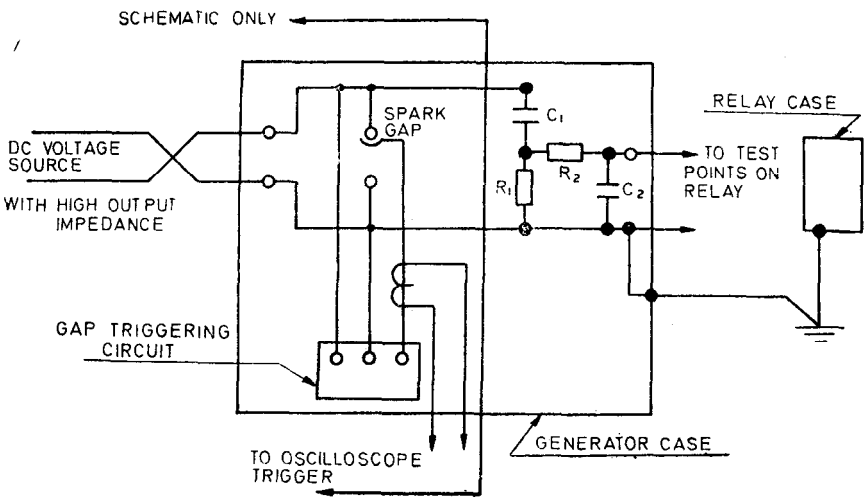
5.2.4.3 After the test the relay shall still comply with all relevant performance requirements specified in IS : 3231-1965*.

NOTE — Owing to lack of experience with relays having static output circuit no proposals are being made at this stage for such relays. It is suggested that till sufficient experience is gained, the high frequency disturbance tests should be non-mandatory for this type of relay.

5.3 Environmental Tests

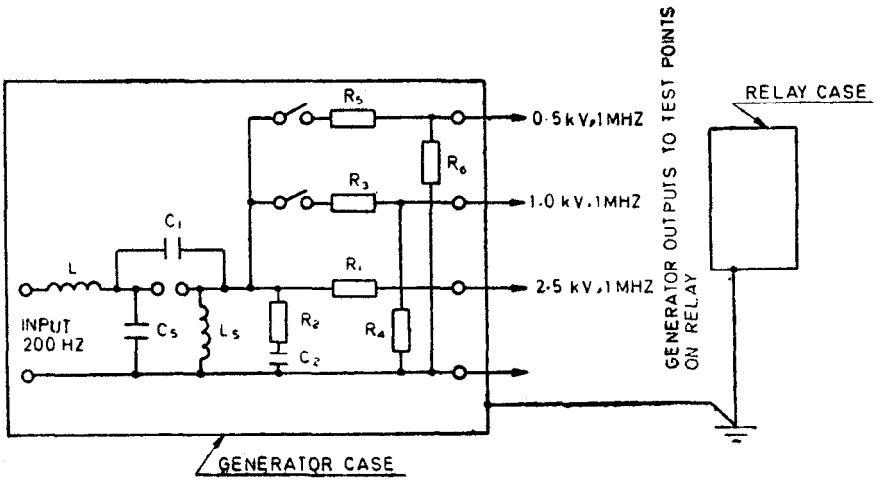
NOTE — The environmental tests are under consideration. For the time being such tests shall be subject to agreement between the manufacturer and the purchaser.

*Specification for electrical relays for power system protection.



Component	*Test Condition*	
	5 kV	1 kV
R_1	1 800 ohms	180 ohms
R_2	500 ohms	500 ohms
C_1	0·035 μ F	0·6 μ F
C_2	0·000 8 μ F	0·000 8 μ F

FIG. 1 CIRCUIT FOR IMPULSE GENERATOR

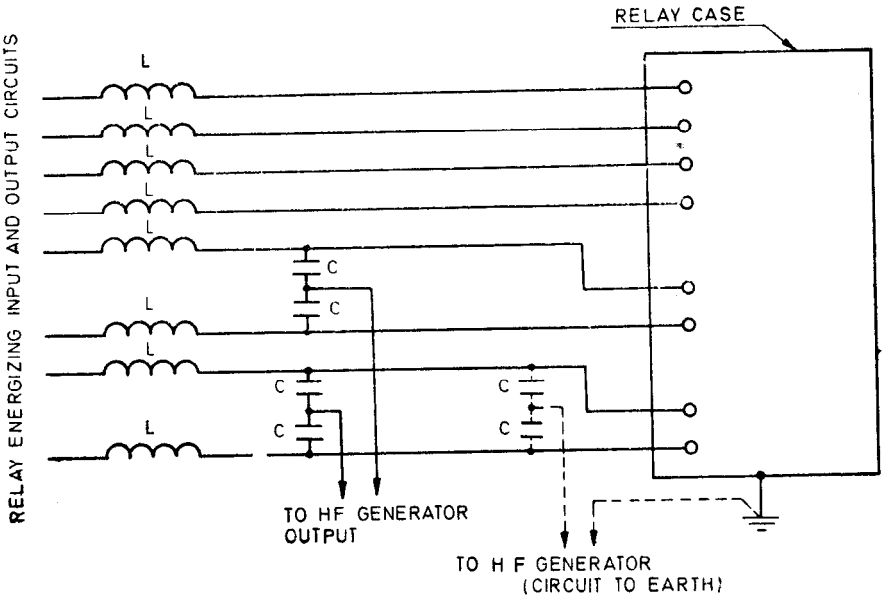


L	= 26 H	R_2	= 100 Ω
C_1	= 20 nF	R_3	= 500 Ω
L_5	= 6·3 μH	R_4	= 333·3 Ω
C_5	= 4 nF	R_5	= 1 000 Ω
C_2	= 80 PF	P_6	= 250 Ω
R_1	= 200 Ω		

NOTE 1 — The U.H.F. Filtor R_2 C_2 is optional as determined by experiment.

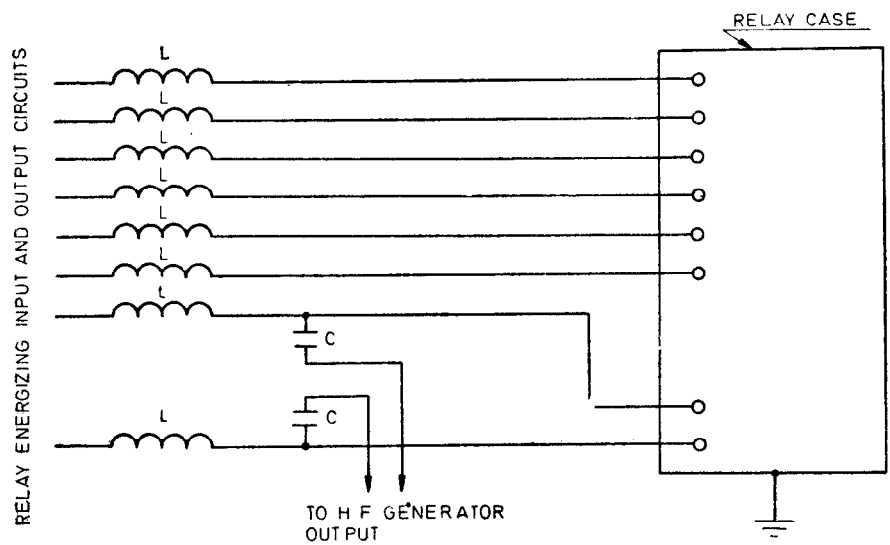
NOTE 2 — If oscilloscope is connected in circuit for checking output parameters it should be switched out of circuit when applying test to the relay for safety reasons.

FIG. 2 CIRCUIT FOR DAMPED OSCILLATORY WAVE GENERATOR



L = 1 to 5 mH (between circuits)
C = 0·5 μ F

FIG. 3 COUPLING CIRCUIT FOR HF DISTURBANCE TEST—LONGITUDINAL MODE



C = 0·5 μ F
L = 1 to 5 mH

FIG. 4 COUPLING CIRCUIT FOR HF DISTURBANCE TEST—TRANSVERSE MODE

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